Environmental FACT SHEET

Canadian Sheet Steel Building Institute

2

March 2014

Cool Metal Roofing - Questionable Value in Cold Canadian Climates

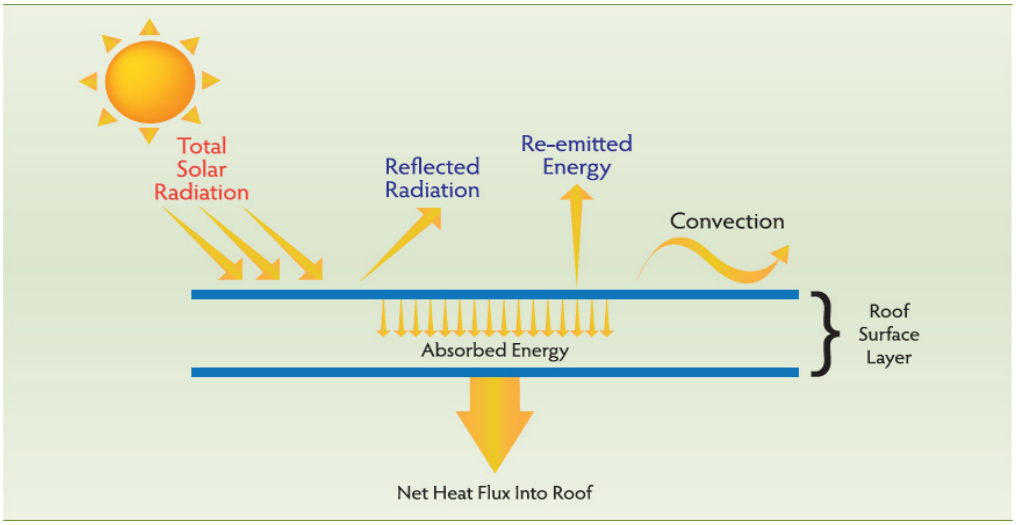
It's a fact that buildings consume two thirds of all the electricity produced in North America and one third of all the energy produced in North America. While it is recognized that adding insulation under the roof surface can reduce cooling and heating costs, there is a diminishing return on the strategy of increasing insulation to conserve energy costs. This is where "cool roofing" can play a role in further reducing the energy consumed, and in minimizing the Heat Island effect created in the big urban cities. Cool roofing relies on sustainable, energy efficient, coated steel products, in a wide variety of finishes, colours, textures and roofing profiles. It conserves energy through its properties of reflectivity and emissivity.

Reflectivity

Reflectivity is the ability of the roof to reflect solar radiation back into the atmosphere. Its primary measure is solar reflectance - the proportion of the total solar radiation that is reflected back to the atmosphere. Any solar radiation that is not reflected is absorbed into the building envelope, requiring further energy to cool the building; or partially convected into the atmosphere increasing the ambient air temperature in the surrounding environment (Heat Island effect). This secondary measure is the Solar Reflectance Index, which takes into account the cooling effect of wind passing over the roof.

Emissivity

Emissivity is the ability of the roof to re-radiate absorbed solar infrared radiation back to the atmosphere. This takes place at all times, but mostly at night. Its measure is Infrared Emittance - the proportion of absorbed infrared solar radiation that is re-emitted back to the atmosphere. Most unpainted metallic coated steels have low emissivity (less that 0.12), while prepainted steels (regardless of colour) have emissivity values of around 0.9.



Canadian Sheet Steel Building Institute
652 Bishop St. N.
Unit 2A
Cambridge, ON
N3H 4V6
Tel: (519) 650-1285
Fax (519) 650-8081
www.cssbi.ca

Agencies Promoting Sustainable Design

There are a number of agencies, but three in particular that are connected to Cool Metal Roofing:

- **Cool Metal Roofing Coalition**, educates architects, owners, specifiers, and code officials on the energy related benefits of steel roofing and siding;
- Energy Star, which provides a standard and qualification process for Cool Metal Roofs; and
- Canadian Green Building Council (and the parent US Green Building Council), which administers the LEED™ (Leadership in Energy & Environmental Design) program. LEED provides a certification program for sustainable "green" buildings, which rewards the use of Cool Metal Roofing.

Energy Star

Energy Star compliance requires an Initial Solar Reflectance of no less than 0.65 for roof slopes of 2:12 or less, and 0.25 for roof slopes greater than 2:12. Energy Star also requires that the solar reflectance after three years be no less than 0.50 for roof slopes of 2:12 or less, and 0.15 for roof slopes greater than 2:12.

LEED

LEED-NC credit 7.2 previously required Energy Star compliance. However, the new LEED standard (for Canada as well as the USA) has discontinued specifying Energy Star reflectivity and emissivity requirements and has introduced Solar Reflectance Index (SRI) requirements in its place. SRI values of no less than 78 for roof slopes of 2:12 or less, and 29 for roof slopes greater than 2:12 is required by the LEED standard.

Compliant Cool Metal Roofs

Canadian steel producers have incorporated cool roofing pigments in their new prepaint product offerings starting in 2008. Selected colours are now capable of meeting the SRI requirement of LEED. These products also meet the Energy Star requirements for solar reflectance where specified. None of the cool metal roof pigments have been in commercial use long enough to verify the Energy Star requirements for three-year Solar Reflectance. It should be noted, however, that 55% Al-Zn coated steel meets the Energy Star requirements for initial and three year solar reflectance, but not the LEED SRI requirement of 78 for low slope roofing.

What is Important in Canada

In Canada, over the course of a full year, winter "heating load" conditions have a greater influence than the summer time "cooling load" because of the much longer and colder winters experienced in Canada. The degree of influence depends primarily on the geographic location, the insulation level in the roof assembly, and the cost of energy. For example, heating loads in Winnipeg, Manitoba are much higher than in Windsor, Ontario because of the greater number of heating degree-days in Winnipeg.

Calculations involving solar reflectance and emittance can be used to determine the energy savings attributable to a roof. Cool metal roofing can reduce energy costs associated with air conditioning. For cooling loads, it is advantageous to reflect as much solar radiation as possible, and to re-emit as much of the absorbed infrared radiation as possible. However, for energy savings associated with heating loads, absorption of solar infrared radiation is beneficial, and it is best to retain absorbed solar radiation, and not emit it back to the atmosphere. In other words, for Canadian climates, it is best to have roofing products with high reflectivity and low emissivity.

Calculated Energy Savings Comparisons

Using the DOE Cool Roof Calculator, a comparison was made between four roof materials on an identical 20,000 square foot commercial building for five Canadian cities. The roof of this hypothetical building has a low slope of less than 2:12.The base case (benchmark) is a black roof, which could be asphaltic, membrane, or metal. The roofs of two of the four roofs are made from prepainted steel - Perspectra Series, Dark Red (QC 18250), and Bright White (QC 18783). The fourth roof is made from 55% Al-Zn coated steel with a resin coating. Table 1 provides the reflectance and emittance values for these four roofing materials.

Table 1: Low Slope Roofing Material Properties

Material	Solar Reflectance (Initial)	Solar Reflectance (3 year)	Emissivity (Initial)	Solar Reflectance Index
Black (QC18262)	0.05	n/a	0.88	0.30
Dark Red (QC 18250)	0.24	n/a	0.85	24.4
Bright White (QC 18783)	0.66	n/a	0.85	78.9
Galvalume Plus™	0.67	0.58	0.12	53.5

The initial Solar Reflectance and initial Emissivity values were used to calculate energy costs for the Black and Prepainted roofs, on the assumption these would lose 5% of their reflectivity after 3 years. When the three year values are available, this assumption will be verified. The 3-year Solar Reflectance was used for the resin coated 55% Al-Zn roof.

The DOE Cool Roof Calculator (ref. US Department of Energy Oak Ridge National Laboratory, Version 1.2) was used to determine annual energy costs. The roof insulation value was R20; air conditioning was by electricity at $0.20 per kwh with average equipment efficiency; heating was by natural gas at $1.00 per Therm with average furnace efficiency. Two colder climate cities were chosen (Winnipeg and Montreal); the other three cities were from among the warmest in Canada as these would benefit most from Cool Metal Roofing (Vancouver, BC; Windsor, Ontario; and Toronto, Ontario). Table 2 shows the annual energy savings compared to the base case black roof.

Table 2: Annual Energy Cost Savings (compared to a Black roof)

Roof Colour	Vancouver	Winnipeg	Toronto	Windsor	Montreal
Dark Red	-1.5%	1.2%	2.4%	3.2%	1.9%
Bright White	-7.8%	1.7%	6.8%	9.6%	4.8%
Galvalume Plus™	10.8%	8.9%	9.5%	10.5%	8.6%

The Dark Red roof provides minor energy savings only in Windsor and Toronto, which experience relatively mild winters, and a good deal of hot weather in the summer. The Dark Red and Bright White roofs are a detriment in Vancouver which experiences mild winters and moderate summers. Bright White offers little advantage in Winnipeg, but significant savings in Windsor, Toronto and Montreal. However, the best choice for maximum energy savings regardless of location is a 55% Al-Zn coated steel roof. Its high reflectivity provides benefit in summer by reducing the cooling load, and its low emissivity provides benefit in winter by retaining heat and therefore reducing the winter heating load.

Conclusion

Cool Metal roofs, with both high reflectivity and high emissivity, offer significant savings in reducing cooling loads. By definition, cool roofs reflect much of the solar radiation, and that which is absorbed is re-radiated by virtue of high emissivity. This is beneficial in predominantly warm climates like the southern US. The state of California has now recognized that different climatic conditions require different approaches. California has sixteen climate zones from north to south; however, they have exempted three of the sixteen climate zones (cold climates) from their Cool Roof (Title 24) regulatory requirements in recognition of the fact that colder climates are not well served by Cool Metal roofing.

In Canada, heating load predominates even in the warmest cities. Energy savings in Canada can be achieved by selecting materials with low infrared emissivity. Prepainted, asphaltic and membrane roofs have high emissivity and therefore re-radiate much of absorbed infrared solar radiation at night - a detriment in winter when absorption heat should be retained to reduce heating loads. A 55%Al-Zn roof combines the benefit of high reflectivity, which reduces summer cooling load, with the benefit of low emissivity, which reduces winter heating loads.

In Canada, the best choice for energy savings is a roof with high solar reflectance and low infrared emittance. However, it should be noted that if a building project stipulates Cool Roofing properties, CSSBI fabricator members have products that meet the reflectivity and emissivity requirements.

Learn more about Cool Roofing from:

Cool Roof Calculator	www.coolmetalroofing.org/elements/uploads/fckeditor/File/SRIcalc9.xls
California Title 24	www.energy.ca.gov/title24
Canadian Green Building Council	www.cagbc.org
Cool Metal Roofing Coalition	www.coolmetalroofing.org
Cool Roofing Rating Council	www.coolroofs.org
Carbon Footprint	www.carbonfootprint.com
ASHRAE	www.ashrae.org
Green Building Initiative	www.thegbi.org